CONST management has developed and implemented construction controls which provide the means to manage the construction effort, track progress, evaluate the schedule, and project milestone and completion dates. This has been an evolutionary process, affected by the stages and type of construction activities required, but has resulted in what TVA considers to be a very effective process for controlling the construction of a quality installation.

2.2.1 Work Control

The Construction Engineer administers all construction work through the work package program. Elements of work are defined into manageable segments which can be accomplished by a typical craft work unit on a one week to one month schedule. These work packages are defined in a way that clearly identifies the construction unit/ discipline responsible for the work, and the work package activities are integrated into the project schedule by developing a work logic sequence and durations for each work package.

These work packages are prepared by the engineers in the construction engineering organization, reviewed and approved through a formal process, and are then issued to the craft supervisor. Development of the work packages involves the craft supervisors in determining prerequisites, work logic, work place planning, etc., to ensure that the elements of work can be accomplished within the confines of space, material, manpower, and other resources allocated. The work packages contain all the information required by the craft unit to perform the work including copies of controlled drawings and specifications, and documentation and inspection requirements.

After the work is completed and the feature has been transferred to operations (NUC PR), any additional work which may be required is controlled under a similar concept called a work plan. These work plans are prepared by engineering personnel, reviewed and approved by NUC PR, performed by the craft, and documented and inspected by engineering and/or quality control inspectors.

2.2.2 Quality Control

The Construction Engineer provides work control through the quality control and inspection process. All the QC inspectors and the craftsmen are properly trained and certified, and each engineering discipline (civil, electrical, mechanical, instrumentation, and welding) has both an engineering function and a separate inspection function. These two functions are carried out independently, each being managed by an Assistant Construction Engineer.

As work packages are issued by the engineers, appropriate hold and inspection points are noted. The craftsman completes the installation to the specified hold points, and calls for a QC inspection. Once the QC inspection is performed and the work is accepted, the installation is continued.

Note that this inspection function is a separate role from the audit function performed by the site Quality Assurance Unit.

2.2.3 <u>Production Control</u>

Production control is accomplished through the use of an integrated schedule using the work package units as the scheduling increment. These work elements are scheduled prior to the work being performed, through a prerequisite logic process, and entered into the schedule. The key transfer or preoperational test activities affected by the work element or work sequence are identified and used to establish the priority of work in progress. A project status reporting system is used which reflects progress in terms of projected versus spent man-hours and material demands.

OEDC has consistently employed productivity improvement methods to point out weak areas in sequence and work control as well as production losses. This is done through work sampling techniques to determine work force utilization and sources of lost or ineffectively spent time. These results are applied through craft management actions to correct and improve areas subject to such improvement.

2.2.4 <u>Requirements and Document Control</u>

The construction management has an active program designed to identify and control requirements received from EN DES and to ensure that such requirements are accomplished.

Documents conveying requirements are identified by the designer and tracked and controlled by the construction site. The principle sources of design requirements are design drawings, construction specifications, vendor drawings and manuals, and contract specifications.

Verification that all implementation requirements have been met is essential throughout the construction phase and becomes a critical issue in the construction wrap-up. The Watts Bar construction project recently developed a Construction Requirements Manual (CRM) which contains requirements in a single resource reference to assist in assuring all requirements are being met.

The construction project has a Quality Control and Records Unit (QCRU) whose major function is document distribution and control. All drawings and other documents containing design information are received and controlled by the QCRU. A reference library containing all versions of site procedures as well as pertinent referenced codes and standards is maintained in the QCRU.

All design information issued to the crafts and/or engineers is issued on controlled distribution by the QCRU so that changes may be updated in a timely fashion to prevent use of superceded information for the construction of safety-related plant features.

All design drawings are issued to CONST with a letter of transmittal, which CONST signs certifying receipt and returns to the design organization.

Site procedures are developed by engineering personnel who convert the requirements from upper-tier documents (manuals) and referenced standards into general and discipline-oriented procedures which describe the subject requirement in detail complete enough to permit a properly trained craftsman, technician, engineer and/or inspector to perform their assigned responsibilities. The number of site procedures and the detail of information provided is controlled by project management with the objective of providing adequate instructions to the user.

Site quality procedures take three forms. Quality Control Instructions (QCI's) are developed to provide direction for those actions affecting quality other than quality control inspections. Examples are the issue and control of NCR's, the sequence for pipe installation, the control of field procurement requests, etc.

Quality Control Procedures (QCP's) are developed to describe quality control inspection requirements and contain inspection criteria and recordkeeping requirements. Inspection of bolted connections, disassembly and reassembly of nuclear components, etc., are examples.

Quality Control Test Procedures (QCT's) are developed as part of the construction test program and become the test package document which establishes test parameters and test conduct for system hydrostatic tests, cold hydro etc.

These site procedures are developed and controlled under the supervision of the Construction Engineer and issued by the QCRU. All activities performed on the construction site must be conducted in conformance with procedures and parameters provided in site procedure documents.

A feedback system is in effect which provides a means for the user of site procedures (or upper-tier documents) to provide input to the preparer concerning the technical adequacy, efficiency or appropriateness of requirements.

2.2.5 <u>Change Control</u>

Change control is accomplished through a unified Field Change Request (FCR) and Engineering Change Notice (ECN) system. All changes required to design drawings are accomplished through an ECN process which is used by EN DES to notify CONST of a pending change. The ECN is followed by a reissue of the affected drawings.

When field changes are required due to constructability problems or other reasons, an FCR is proposed to EN DES by CONST. If the FCR is approved by EN DES, CONST is notified that an ECN will be issued and followed by the revised design drawing.

Both the ECN and FCR are controlled programs which are tracked and closed once completed by the construction site.

2.2.6 <u>Accomplishment of Design and Construction Requirements</u>

Accomplishment of design and construction requirements and verification of the completion of these requirements is of major concern to the construction project. The assurance that all requirements have been met is a comprehensive program at Watts Bar that has evolved over the life of the project.

The completion of the scheduled work packages/plans is the first way of administratively verifying that requirements have been completed. This is coupled with a procedurally controlled "as-constructed" program in which construction prepares a marked up "as constructed" version of each design drawing. This "as constructed" data is returned to EN DES where the final configuration is reflected on the design drawings, verifying that the actual installation requirements have been accomplished.

Verification that installation is complete is inadequate to assure that requirements imposed during the installation process were met (such as material verification, weld fit up, equipment installation requirements, cleanliness tests, etc.); hence CONST has developed an Accountability Program for ensuring that required inspections, tests, and examinations have been conducted.

The Accountability Program is a system by which items which fall under the Quality Assurance Programs are identified, and the required inspections, tests, and examinations to be conducted for each item are specified by a test code. This data is automated on a computer program. As the approved record of each inspection, test, or examination is received by the QCRU, the appropriate test code for that item has a "complete status" entered.

The required tests, inspections, and examinations are described by site procedures and incorporate all requirements specified by the designer.

Thus, when all test codes for the identified quality related item are in the "complete status," another level of assurance that requirements have been met has been developed and that the work related to that item is complete. Items such as welds, pumps, tanks, valves, piping segments, cable, panels, electrical devices, and systems tests are tracked in this manner.

The posting of test status in the accountability program is independent from the organization conducting the inspection, test, or examination and provides added assurance that the work has been completed and the records accounted for.

2.2.7 Records Accounting

Records management and accounting is as important to the construction program as installation from a quality view point, and the project management has continued to be attentive to the development, review, storage and accounting of all records.

A records vault is located on the project under the control of the QCRU supervisor. This vault provides temporary storage for all completed records until such time as they can be microfilmed and transferred to NUC PR. The vault is a fire resistant, environmentally controlled area designed to provide temporary storage of records.

Access to completed records is controlled to ensure the availability of records when needed. Records are categorized as "life of plant" or assigned a duration of retention in accordance with established procedures. A records filing system and records index is inplace which provides for retrievability of all stored records. All records of inspections, tests, examinations, vendor contracts, Code Data Reports, and other records of activities related to or affecting safety-related structures, systems, components or actions which are one-of-a-kind records are stored in the vault.

As described in section 2.2.6 above, the accountability program is used to identify required records before they are generated, to track the status of the record, and to provide final assurance that the record has been placed in the storage vault in acceptable condition. Prior to being finalized, records are reviewed against established acceptance criteria to determine acceptability. This process has had shortcomings in the past at Watts Bar, and the project began several months ago to review 100 percent of the existing records against current acceptance criteria to assure the records are adequate. This problem area is discussed further in Section V.

2.2.8 Identification and Control of Materials, Parts, and Components

The construction project has a well defined materials, parts, and components control program which is enforced by construction management to assure proper receipt, identification, issue, installation, storage, and handling of materials on the construction site.

A materials receiving process is defined and inplace which assures that receiving inspections evaluate incoming materials against the procurement specifications. Each quality related item received on the site is verified as being in conformance with specifications prior to being accepted for use during construction. During this receiving inspection, the following actions are accomplished:

a. Assign proper storage.

b. Specify initial and periodic maintenance requirements.

c. Ensure special handling documentation is provided.

d. Initiate a nonconformance report when items do not meet requirements.

e. Review QA records for acceptability and completeness.

f. Document the receiving inspection by report.

Material, part or component identification and marking is accomplished individually or in groups using tags, name plates, or other acceptable methods prior to being placed in storage. The contract number, TVA Mark Number, or NSSS identification number, manufacturer part number, contract item number, description or name, heat number for permanent material if required, specification number, etc., are included in this identification marking as appropriate. This marking is done so that the items can be traced back to the procurement contract as required during any phase of construction. Transfer of markings for pieces rendered or separated from received stock is formally controlled by site procedures.

Storage of material conforms to the requirements of the manufacturer to ensure that it is in acceptable condition for use in the nuclear plant. TVA provides several classes of storage facilities ranging from controlled humidity and temperature storage to outdoor storage, depending on the specified storage conditions.

Material issue control is accomplished through a formal withdrawal procedure requiring the engineer responsible for installation to review and approve a withdrawal request before the craft can obtain material, parts, or components from the warehouse for installation. Once material is released, the craft supervisor is responsible for the protection and safekeeping of the material until installation is complete.

Upon installation, a quality control inspection is made and recorded which verifies that specified material and withdrawn material match the material actually installed. Name plate data and other manufacturing information are verified as correct in the case of parts or components.

Periodic storage inspections are conducted by the responsible inspection unit to ensure that material, parts, and components are being properly stored and maintained during storage. All items requiring regular maintenance are placed in a maintenance program, and the required maintenance is performed at specified intervals until the item is transferred to NUC PR.

2.2.9 Control of Tools, Measuring and Test Equipment

The use of tools, measurement, and test equiment is controlled through site procedures and inspection requirements to ensure that the tools and equipment used in installation and testing of safety-related items are properly calibrated and maintained.

All measurement and test equipment and specific tools requiring control are permanently identified and placed in a program which establishes regular maintenance and calibration intervals, and tracks the status of the maintenance and calibration for each device.

Calibration is accomplished onsite or at other service units within TVA using certified calibration equipment based on nationally recognized standards or techniques. A record of the calibration and date is maintained as a QA record, and used when necessary to verify the calibration status of the device. A tag or sticker is affixed to the device after calibration noting the date of calibration and the due date for the next calibration. This is to prevent the use of an uncalibrated device. Calibration intervals may be adjusted to accommodate job requirements.

In the event an instrument is found to be out of calibration, all work checked or performed with that instrument since the previous valid calibration is considered unacceptable and is rechecked unless it can be determined that all requirements have been met. The out--of-calibration instrument is tagged to prevent use until recalibrated.

2.2.10 Field Procurement

The procurement of major plant features, systems, components, etc., is generally the responsibility of the design organization. CONST does have authority to procure construction related items and services as the need arises following approved guidelines.

The construction engineering organization reviews and approves all site quality related procurement requests. The Watts Bar CONST site QA Unit reviews all site initiated procurements having QA requirements which are not processed by the design organization.

Vendors selected to provide safety-related items must be approved. EN DES provides a list of approved vendors whose QA programs have been reviewed and judged acceptable. When other vendors are used, approval must be verified before the contract award can be made.

All procured items have quality levels and requirements specified in conformance with those established by the designer. The receipt and control of site procured items are the same as items provided through design initiated contracts.

2.2.11 Control of Special Processes

Special processes such as welding, heat treating, nondestructive examinations, ASME Code fabrication and installation, etc. which are applied in the fabrication, erection, or installation of nuclear plant systems, structures, or components are controlled by site procedures, training and certification programs, and inspection or surveillance programs. This results in well documented, quality installation which is acceptable under the applicable codes and standards.

General Construction Specifications and the ASME Nuclear Compliance Manual (NCM) have been developed by EN DES to describe program requirements for controlling special processes. Examples of subject areas contained in these compliance manuals are welding of safety related items;

nondestructive examinations; heat treating; fabrication and installation of ASME Code systems, parts, components, appurtenances, etc. (piping, equipment, valves, supports, etc.); and field installation control and verification requirements for electrical and instrumentation devices requiring such documentation for compliance with environmental qualification guidelines.

These requirements have been converted to site procedures describing the process control system which applies to the use of such special processes. These site procedures provide:

a. Acceptance criteria

b. Definition of physical parameters of the special processes (welding conditions, etc.)

c. Fabrication and installation control sequence including specification of hold points for required inspections

d. Inspection records

e. Test requirements and associated records

f. Third party inspection program (Authorized Nuclear Inspector)

g. Records control

h. Personnel qualification requirements and records

i. Material control, verification, and records.

The work packages released to the craft for the performance of work requiring special processes contain clearly identified parameters for application of the special process, including such information as type of weld, weld process to be used, certification level of the welder, etc.

Additionally, certification of the individual performing special process work or inspections is an entry on the final record of the work or inspection. This entry is reverified during the records review process conducted by the QCRU prior to the record being finalized. This provides added assurance that only qualified employees are performing such work to specified procedures.

As an ASME Code "NA" certificate holder, TVA CONST has added an additional program to the assurances already in place. An N-5 Code Data Report Preparation Unit has been established at Watts Bar in the interest of performing a final review of all safety related ASME Code piping system installation records prior to stamping and final transfer of the systems. This unit is currently in the process of (1) reviewing all fabrication, installation, inspection, and testing records; (2) ensuring that the actual installation, the fabrication drawings, the process control records and the component Data Reports are consistent; and (3) ensuring that the system meets established requirements.

2.2.12 Construction Testing

OEDC has developed and implemented a construction test program which demonstrates that tested structures, systems and components will perform satisfactorily when preoperationally tested and put into service. This construction test program is in effect a continuation of the Accountability Program described in section 2.2.6, but concentrates on the verification that the installed "system" as well as the "element" (which is more the subject of the accountability program) will function properly. The construction tests are performed on systems and components of unlicensed nuclear units to satisfy prerequisites to the preoperational test program. These include pressure and other integrity tests, component, and piping system cleaning and flushing, equipment checkout, and initial operation and adjustments.

The construction engineering organization develops a test matrix which defines the tests to be performed on each component, system, etc., requiring tests. This test matrix is reviewed and approved by EN DES.

The construction engineering organization then develops test procedures detailing how to conduct the tests, identifying supporting information, and providing the forms used to identify equipment and components to be tested. Using these procedures, Construction Test Packages are developed for each test which details how the engineers and craftsmen will actually conduct the test. The package uniquely identifies the system or portion of the system, equipment, or component being tested, the configuration for the test, and the test instrumentation. These procedures and test packages are reviewed by EN DES, CONST QA, and NUC PR (the operator) as appropriate.

EN DES reviews the test information, test requirements, and acceptance criteria.

Construction conducts the tests with the assistance and support of NUC PR, and prepares a test results package containing all collected test data. This test package is reviewed by CONST QA, the responsible engineer, and the designer and NUC PR as appropriate. The validity and acceptance of the test is verified, and the test results package becomes a QA document, which is filed in the QCRU.

This construction testing program is currently being conducted at Watts Bar Nuclear Plant. These construction tests are tracked in a status program at Watts Bar which is a part of the Accountability Programs.

2.3 Quality Management Functions

There are several key management functions which are important to ensure quality workmanship in the construction of a nuclear plant. OEDC has recognized the importance of these key functions and has assigned these specific responsibilities to key managers as primary duties which do not routinely take lower priority to production tasks. The key quality management functions include:

a. Reviewing all noncompliances, investigating the specific cause and determining root causes.

b. Coordinating of corrective actions and establishing realistic schedules of completion.

c. Preparing of responses to the audit organization.

d. Working closely with site QA auditors and NRC inspectors.

e. Reviewing, and coordinating site procedure changes which result from deficiencies.

f. Organizing site QA training and retraining required as a result of noted deficiencies.

g. Acting as lead coordinator responsible for resolving quality issues with the design organization.

The timely accomplishment of these actions has become increasingly critical at Watts Bar Nuclear Plant, and the project management has recently established a separate "Quality Management" unit (separate from the Quality Control, Quality Inspection, or CONST Quality Assurance site units) and has charged the manager of this new unit with all of these key functions.

Management reviews are conducted regularly to verify the implementation of the construction program in fulfilling these key functions. These reviews involve the site managers and representatives of the designer and operator as needed. These reviews address the areas of interface control, independence and proper functioning of the engineering and QC units, achievement of production, achievement of quality, and review of requirements and commitments to assess required changes, especially as related to site procedures.

In addition to items identified through this management involvement, the construction project management continually emphasizes the need to promptly identify conditions adverse to quality, report such findings through proper channels, and take prompt, necessary action to correct the deficiencies. This is a responsibility of all site employees.

Site procedures have been developed which describe the process for reporting noncompliances, determining significance, developing and implementing corrective actions, tracking the noncompliances, evaluating trends, and closure. These procedures are included in the new employee training program and periodic retraining sessions which are conducted as required to ensure the familiarity of all employees with the program. The OEDC noncompliance program is discussed in more detail in Section III.4.0.

To benefit site management, a noncompliance tracking system, which follows the status of all open NCR's, QA Audits, NRC items, etc., is in place and accurately tracks all open items from opening through the corrective action and close out process. The Construction Engineer and his assistants regularly review the status of open items, reassigning priorities as needed, and verifying the corrective action status.

The project management, through the quality assurance responsibilities of the Construction Engineer, exercises the authority to stop work when noted deficiencies appear to be broad in scope and have potential for serious quality impact if work continues. The stop work process is documented in site procedures. The CONST Quality Assurance site unit also has this stop work authority. This site QA unit responsibility is discussed in Section IV.

The Division of Construction believes the development of a "quality conscious" attitude in each employee is one of the highest priority objectives for all managers. The job description of each employee (and manager) contains a specific responsibility to become acquainted with and support the TVA QA programs. This commitment to quality within CONST is demonstrated by the training each employee receives.

Each new employee receives training in the areas of quality related construction procedures and TVA's commitment to nuclear safety as well as schedules and quality related reporting procedures. Regular "quality consciousness" seminars are conducted for all levels of site management and employees. All craftsmen involved in special processes such as welding and protective coating application are trained, tested, and certified in the appropriate procedures and skills. All other craftsmen are trained through the organizational structure in procedures used in the performance of their tasks. Apprentice programs have been implemented in all crafts and consist of a multi-year training program covering all aspects of a particular craft. These programs are a combination of classroom work and actual on-the-job performance.

Quality control inspectors are trained in procedural requirements and skills before being tested for certification to perform the particular inspection and documentation. Engineering personnel responsible for safety-related activities are appropriately trained and qualified in procedural requirements and receive sufficient on-the-job training with other working level employees before being allowed to work independently.

3.0 Performance Verification - Integration of Design and Construction with the Operator

TVA's design and construction programs conclude with a performance verification process which integrates the operator, the Division of Nuclear Power (NUC PR), into a program designed to verify through preoperational testing that the systems will function as designed. Active participation in the preoperational testing program gives the operating organization an opportunity to become more familiar with the plant's systems in an operational mode. TVA benefits in this area from the participation of the operator in this test program. The operations organization actually operates the systems involved in the preoperational tests, and by working alongside CONST during the final stages of construction, participate in verifying that the work is completed and the systems function properly.

Since TVA does not provide a turnkey installation to the operator, a transfer process has been implemented which provides for orderly transition in the transfer of systems, and subsystems, and features from CONST to NUC PR.

3.1 Transfer Process

When CONST has completed sufficient construction and testing of a system or feature to allow the preoperational testing to start, the transfer process begins. A transfer document is prepared which documents the system or feature configuration. First, CONST walks down the system or feature and prepares a listing of remaining work items. This listing is designated as the incomplete work items list and is included in CONST's "Punch List" which contains all outstanding work remaining to complete the feature being transferred (including open deficiencies, incomplete documentation, etc.).

NUC PR reviews this package and verifies that the transfer document reflects the actual configuration of the system or feature. NUC PR also indicates the items on the "Punch List" which must be completed before preoperational testing can be performed. They also identify any additional items they deem necessary for completion before NUC PR accepts the system for transfer.

CONST completes all the work items designated by NUC PR as being prerequisites for preoperational testing, and NUC PR and CONST execute a Tentative Transfer document. The remaining "Punch List" items are issued as the Official Outstanding Work Items List (OWIL). This tentative transfer authorizes NUC PR to begin controlling the operation and maintenance of the system thus allowing NUC PR to conduct the preoperational tests as described in the next section. CONST, however, retains the responsibility to complete outstanding work on the feature or system under a NUC PR approved work plan until Final Transfer.

Once NUC PR completes the preoperational tests verifying that the system has performed satisfactorily, and CONST has completed all modifications and other outstanding work, the system or feature is ready for Final Transfer. CONST and NUC PR jointly execute a Final Transfer document and NUC PR assumes total responsibility for the system or feature.

3.2 Preoperational Testing

The preoperational testing program verifies that the plant systems and features important to nuclear safety meet an established set of acceptance criteria and prove these systems and features can perform their intended safety functions as designed. For Watts Bar Nuclear Plant, TVA is committed to a preoperational testing program which complies with Regulatory Guide 1.68 RO (11/73).

The implementation of this program within TVA is defined in ID-QAP-11.1, the Interdivisional Quality Assurance Procedures Manual, "Preoperational Testing." This procedure defines the responsibilities of CONST. EN DES, and NUC PR in accomplishing preoperational testing. These responsibilities are established in a manner which allows each division to accomplish its own work in an efficient manner and yet provides adequate overlap to allow appropriate verification.

EN DES has overall responsibility for establishing the preoperational testing program for each plant. To accomplish this task, EN DES identifies the preoperational tests which must be performed and issues scoping documents for each test. The scoping document provides a description of the testing to be performed; safety precautions to be followed; identification of test objectives; means of performing the test; prerequisites to be completed prior to testing; required environmental conditions; justification for any proposed degree of simulation less than full simulation; and specific acceptance criteria. This scoping document defines the minimum level of acceptable testing which must be accomplished by the preoperational test.

Once the required preoperational testing program is established, CONST and NUC PR jointly determine the schedule for performing the tests and integrating the tests with the overall construction schedule.

NUC PR is responsible for preparation of the preoperational test instruction which is the detailed, step-by-step instruction by which a test is conducted. Each step includes a space for signoff to verify completion of the indicated actions and compliance with the acceptance criteria. The preoperational test instruction must be reviewed by EN DES and CONST and approved by EN DES prior to issue.

Prior to start of a preoperational test, the system or feature is tentatively transferred from CONST to NUC PR as described in the previous section. The preoperational test is performed by NUC PR, utilizing the operating organization personnel who will start up and operate the plant after licensing to operate the systems being preoperationally tested. The data taken is collected in a test results package. The test results package consists of the issued preoperational test instruction with each signoff point signed and dated to verify the actions taken, all data sheets, instruction change sheets, test deficiencies and exceptions, appendices, a daily log of the testing, and the test record drawings which document the configuration of the plant features at the time of testing.

During testing as test deficiencies occur, NUC PR transmits to EN DES a test deficiency report. This allows EN DES to expeditiously take whatever action is required to resolve the deficiency and to allow retesting if necessary to demonstrate acceptable performance. The test deficiency is formally documented in the test results package which includes a description of the deficiency, a copy of the report form, and the resolution of the deficiency.

When the testing is completed and the results package has been compiled, NUC PR evaluates the results and identifies any items which still require resolution. The package is then transmitted to EN DES.

EN DES reviews the complete results package to verify that the testing performed demonstrated that the system or feature is functioning as designed and that the acceptance criteria were met. As a part of its review, EN DES evaluates any open items identified by NUC PR and establishes an acceptable schedule for determining the resolution of these items and for implementation of the resolution. The preoperational test is not completed until EN DES has given final approval to the results package. Once any required test deficiencies and/or system modifications have been completed, the system or feature is ready for final transfer as described in the previous section.

Within EN DES, the preoperational testing program is coordinated by the Nuclear Safety Systems Group in the Nuclear Engineering Branch. This group coordinates the testing between NUC PR and the EN DES test representatives; oversees the administrative handling of the preoperational testing documents; performs a selected backup review of testing documents to assure that the nuclear safety aspects of the test have been adequately considered; and provides final EN DES approval of all preoperational test instructions and test results packages.

The EN DES test representative, who is assigned overall responsibility within EN DES for the technical adequacy of the preoperational test and for preparation of the preoperational scoping document, reviews and approves the preoperational test instructions and results package and provides any onsite support needed by NUC PR in performance of the test. In general, the EN DES test representative is assigned from the branch or project which has engineering or design responsibility for the system or feature being tested. This assures that the EN DES test representative will be knowledgeable of the design of the system and its functional requirements and is therefore able to determine and implement changes necessary to resolve test deficiencies.

3.3 Noncritical Systems Testing

The noncritical systems testing program was developed to perform functional testing of the plant systems and features which do not serve a safety function in order to verify system performance for economic reasons. Due to the nonsafety nature of the noncritical systems testing program, the program is not described in the FSAR.

The noncritical systems program is implemented in parallel with the preoperational testing program and is also defined in Interdivisional Quality Assurance Procedure (ID-QAP-11.1). The only differences in the processing of noncritical systems documents and preoperational testing documents is that, while EN DES does review a noncritical systems test instruction, EN DES approval is not required prior to issue.

3.4 Postmodification Testing

Postmodification testing is performed when a modification to the plant is made which impacts a system or feature in such a way that a routine maintenance check or surveillance instruction performed by NUC PR would not be sufficient to adequately test all aspects or impacts of the modification. The postmodification testing program is described in ID-QAP-2.4 and ID-QAP-2.5.

As an integral part of the design change control process addressed in Section 1.3.5, EN DES reviews all plant modifications to determine if a postmodification test is required based on the above criteria. If a postmodification test is required, EN DES informs NUC PR and initiates preparation of a postmodification test scoping document.

From this point forward, the performance of a postmodification test is controlled in a manner similar to the preoperational testing program. and the documents are handled in an equivalent manner. NUC PR is required to certify that the postmodification test has been completed and the results are acceptable prior to placing the affected system back into normal operation following the modification.

3.5 Summary

Each of these testing programs provides final assurance that the plant systems have been constructed per the design requirements and will function as intended by the design to ensure safe and reliable plant operation.

4.0 Identification of Conditions Adverse to Quality

A strong quality assurance program must provide the ability for line organizations to identify problems, control work, and correct problems in addition to those documented through the independent audits and reviews. This, we believe, is the essence of Criterion XV and Criterion XVI of Appendix B to 10CFR50.

As previously noted, every employee within the Office of Engineering Design and Construction involved in the design, procurement, and construction activities for the Watts Bar Nuclear Plant is encouraged and has the responsibility and authority to identify conditions adverse to quality; identify any condition which does not appear to conform with requirements; and identify any condition which does not appear to be of desired quality. The majority of these conditions are appropriately identified by the "line" organizations during daily design and construction checking, reviewing, inspecting, and testing activities.

The Division of Engineering Design and the Division of Construction have developed interlocking procedures in this area which control conditions adverse to quality and prescribe the disposition, resolution, and verification process. All conditions adverse to quality are appropriately reviewed for their degree of importance.

Due to the variance in the types of work performed in design as opposed to construction, for example, OEDC has developed several forms for documenting conditions adverse to quality. In EN DES, the primary method used to document a condition adverse to quality (CAQ) results in the initiation of a Nonconformance Report (NCR). This NCR method is effective in EN DES for two important reasons. First, as is true throughout OEDC, any EN DES employee detecting a potential CAQ (a potential nonconformance or failure to comply) is required by procedure to document the CAQ on an NCR form.

Second, EN DES uses a very low threshold to trigger documentation of a CAQ. From information available to TVA, we believe that the documentation of CAQs for design activities is practiced by few design organizations outside of TVA.

Identified CAQ's in both EN DES and CONST are reviewed by supervisory personnel and by the OEDC QA Staff to ensure proper determination of the questionable condition as a CAQ and proper determination of the CAQ as "significant" per the requirements of 10CFR50, Appendix B. For those NCRs classified as "significant," the cause, corrective action, and action to prevent recurrence must be documented on the NCR form. Significant NCRs are reviewed independently by the EN DES licensing staff (NLS) for reportability to NRC-OIE under 10CFR50.55(e) and 10CFR21. Again, TVA uses a very low threshold for reporting to NRC-OIE compared to industry practice. This low threshold is evident both from comments made to TVA by other utilities and by NRC-OIE inspectors, and from the ratio of TVA identified items to NRC reportable items.

Many CAQ's (on NCR forms) are identified on the construction site and, if they cannot be dispositioned onsite, are referred to EN DES for resolution with entries indicating CONST's recommended disposition. These NCR's are transmitted from the CONST project manager to the EN DES project manager. The EN DES project manager transmits the NCR to the appropriate group in design to be dispositioned. Following a technical review of the conditions described by the NCR form, EN DES will either concur with CONST's recommended disposition or will issue a revised disposition.

In the design process, most conditions adverse to quality relate to software and a single CAQ form is adequate. In the construction process, there is a mixture of software and hardware problems. To handle this mixture, CONST uses two records to document conditions adverse to quality. These records are Inspection Rejection Notices (IRN's), which describe conditions of construction incompleteness as identified by QC inspectors; and Nonconformance Reports which are also used by EN DES to document conditions impacting design and/or safety. These documents are originated by the identifying organization and generally reflect conditions which do not meet pre-established acceptance criteria. These conditions are usually identified during the receiving, checking, inspecting, and testing activities.

The procedures developed and implemented by CONST address the identification, documentation, segregation, disposition, corrective action, and verification elements of an effective program for the control of nonconforming items or conditions. The procedures further prescribe communication channels, direct interface between organizations, establish review levels, and require a trend analysis program. As in EN DES, every construction employee at the Watts Bar Nuclear Plant has the authority and responsiblity to identify any condition adverse to quality or to identify any condition believed to be adverse. The intent is to assure that all concerns are addressed and resolved regardless of safety implication. Identified conditions are processed by their degree of importance. For example, Inspection Rejection Notices, since they describe conditions of construction incompleteness which can be brought into conformance with additional trades and labor effort, are not processed in the same manner as a Nonconformance Report which describes a condition impacting the design and/or safety. Nonconformance Reports are dispositioned by construction engineering and coordinated with the appropriate design organization as necessary.

Segregation is an important part of the nonconforming item control process. Two basic methods of segregation are recognized--tagging and/or isolation. Both methods prevent the inadvertent use or further processing of nonconforming materials, parts, or components. In effect, the segregation method places the nonconforming item in a "stop-work" mode. Only by an approved disposition, by correcting, and by verifying can the "segregation" be removed. Controlled "risk releases" are occassionally approved with the stipulation that the item will have to be reworked, repaired, or rejected. The documentation of this condition adverse to quality is left open until rework, repair, or replacement is completed.

The following is a summary of the Conditions Adverse to Quality for the Watts Bar Nuclear Plant as of February 26, 1982.

Document		Conditions	"Significant"	50.55(e)	Open
CONST	IRN	4516	-	-	1347
CONST	NCR	4037	144	106	323
EN DES	NCR	367	273	145	182
Vendor	NCR	222	11	4	0

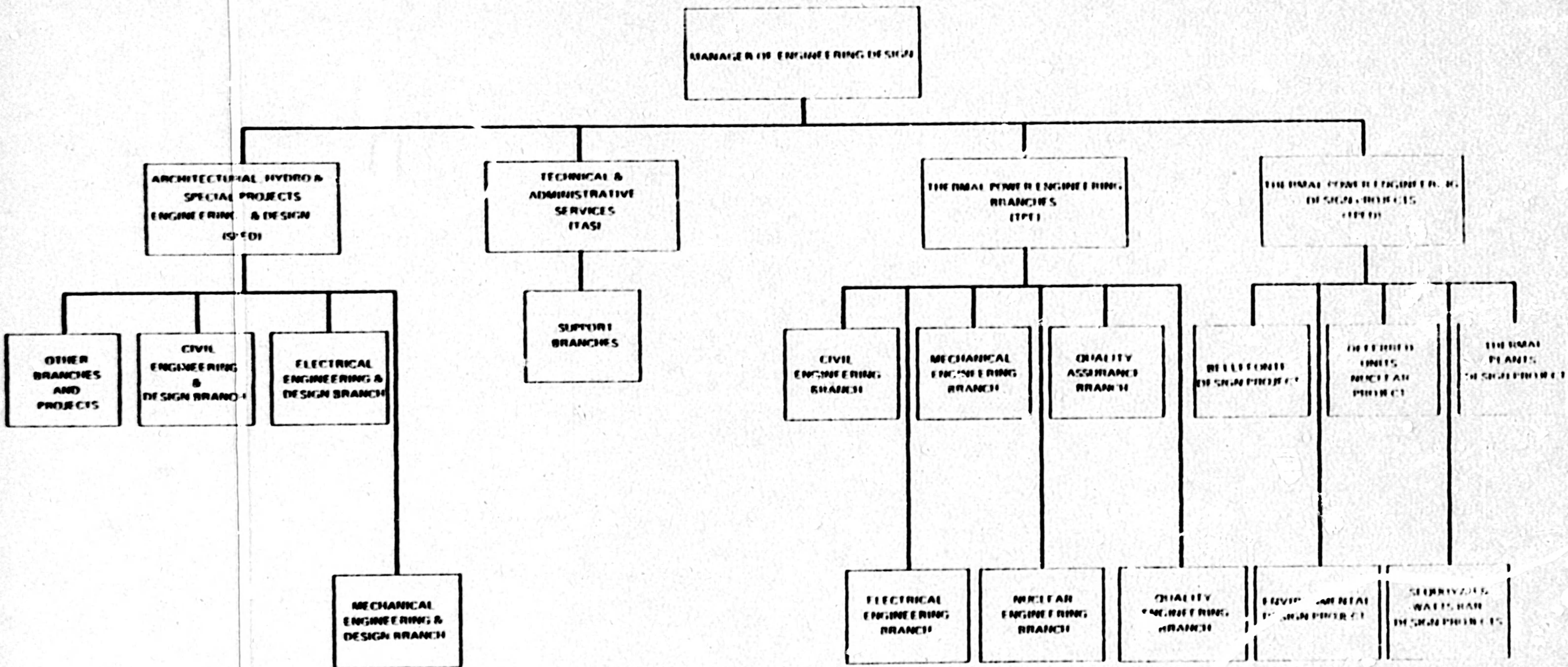

FIGURE P1 – 1
DIVISION OF ENGINEERING DESIGN ORGANIZATION

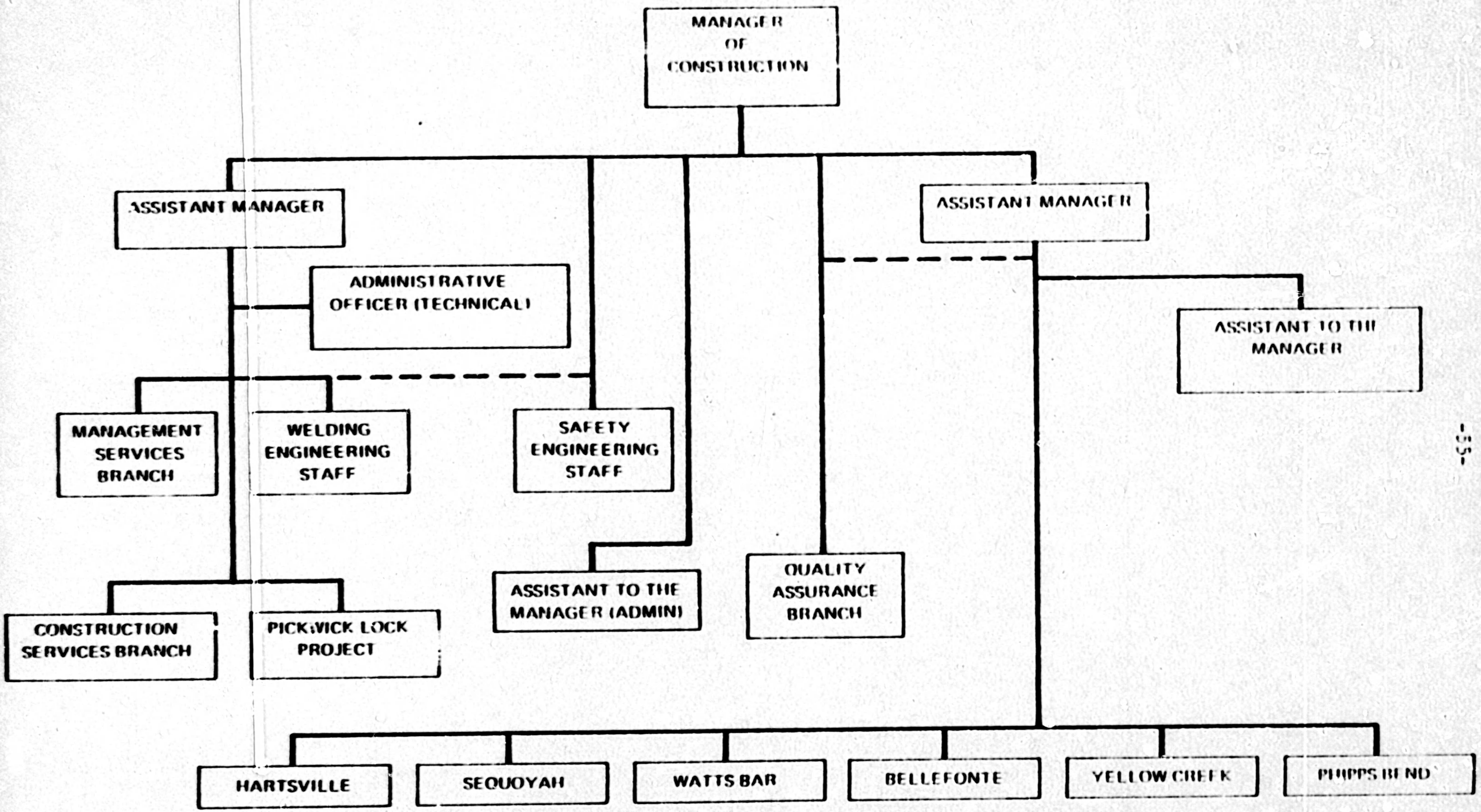

FIGURE III – 2
DIVISION OF CONSTRUCTION ORGANIZATION

IV. Independent Assurance Programs

The OEDC design and construction programs as described in Section III are established and organized to ensure that all commitments made in accordance with the license application are fulfilled and that the underlying requirements of safety and quality are achieved.

However, OEDC does not rely solely on these design and construction programs to assure that these commitments and requirements are met but has established a strong, internal Quality Assurance (QA) program and organization which utilizes a vigorous audit program to review and verify the implementation of all phases of both the design and construction programs. The QA program assures that the design and construction programs conform to the full intent of the 10CFR50, Appendix B criteria, the requirements of Section III of the ASME Boiler and Pressure Vessel Code, the applicable ANSI Quality Assurance Standards, and other regulatory requirements. More importantly, the QA program assures that when shortcomings and deficiencies are identified they are resclved in a timely manner with appropriate steps taken to reduce the possibility of recurrence.

1.0 Quality Assurance Organizations

Ultimately, overall responsibility for quality assurance and quality control is assumed by the Manager of the Office of Engineering Design and Construction (OEDC). To fulfill this responsibility, the OEDC Manager has established three interrelated QA organizations who share the necessary functions of establishing, directing, and auditing the implementation of the QA program covering design, procurement, and construction. These three groups are the OEDC Quality Assurance Staff (OEDC QA), the Division of Engineering Design Quality Assurance Branch (EN DES QAB), and the Division of Construction Quality Assurance Branch (CONST QAB). In addition, a fourth group, the Division of Engineering Design Quality Engineering Branch (QEB), also performs some quality-related functions in the area of supplier surveillance. Management of EN DES QAB, EN DES QEB, and CONST QAB is delegated by the OEDC Manager to the respective division managers. The OEDC QA Staff is a part of the OEDC Manager's staff and is accountable to the OEDC Manager. Figure IV-1 shows these organizations and their relationship to the division managers.

These three QA organizations are independent of those design and construction organizations involved in production activities, and are headed by senior managers of equivalent managerial rank with extensive management experience, nuclear experience, and a broad knowledge of the TVA organization. Their rank is also equal to the highest line manager performing activities affecting quality. Throughout the QA organization, the supervisors and QA engineers have full authority and organizational freedom to identify quality problems; to recommend solutions; to bring quality problems to the attention of the responsible managers; and to verify implementation of solutions. Further, the QA organizations have both responsibility and authority to immediately stop unsatisfactory design and construction activities or prevent further processing of unsatisfactory items through the issuing of stop work orders when continued processing would result in defective items.

The objective of the OEDC Quality Assurance Program is to provide an orderly, systematic, and effective approach to achieve quality workmanship and services in the design, procurement, and construction of TVA's nuclear plants. To achieve this objective requires a strong commitment to QA by both line organizations and management. This disciplined approach first requires that design requirements and construction requirements be clearly and succinctly translated into procedures and controls to guide the work of all those involved in the nuclear program. These procedures and controls must accurately incorporate all regulatory requirements and necessary precautions to ensure that the final product will fully meet all requirements and commitments. To verify implementation of the QA program, the QA organizations conduct a vigorous auditing program. Audits are scheduled, planned, and conducted to assure that the design and construction organizations and their contractors are functioning in accordance with the application of QA policy, and are correctly implementing all the procedural and regulatory requirements of the QA/QC program. If deemed necessary, unscheduled, unannounced audits may be conducted by the QA organizations.

Both of the design and construction QA organizations have established programs which fully meet the 10CFR50, Appendix B Criteria, and the OEDC QA Staff fulfills those Criteria applicable to the staff. Since the OEDC program does not utilize the contracted services of an architect-engineering firm or a construction firm but performs these functions in-house, the QA programs for the designer and constructor are thus conveniently integrated to achieve a more comprehensive OEDC QA program.

In the Manager's Office, the OEDC QA Staff has the responsibility to ensure that this overall OEDC QA program functions effectively and to provide basic policy, oversight, and guidance relative to the EN DES and CONST QA programs. To fulfill these duties, OEDC QA performs several key functions such as establishing the basic QA Program requirements, distributing these upper tier requirements through controlled procedural manuals, coordinating necessary interfaces between the QA organizations, reviewing and approving EN DES and CONST QA procedures for conformance to QA Program requirements, and auditing EN DES and CONST activities to assess compliance to Appendix B criteria and to the QA Program criteria. The OEDC QA Staff Manager reports all major quality matters promptly and directly to the OEDC Manager.

OEDC audit reports are routinely distributed to the Manager of OEDC and to the appropriate division managers. Periodic written and oral reports are prepared to continually keep the OEDC Manager apprised of the QA Program status. A monthly report is routinely prepared for the OEDC Manager which specifically highlights major quality items and progress toward correcting previously identified major items.

The Engineering Design Quality Assurance Branch (EN DES QAB) establishes, directs, and audits the implementation of the quality assurance program established for Engineering Design to fulfill the criteria of 10CFR50, Appendix B. EN DES QAB reviews and approves all EN DES design procedures and audits EN DES organizations for compliance with QA program requirements established in accordance with Appendix B criteria. EN DES QAB conducts training programs in areas such as handling and reporting of nonconformances, quality assurance records' requirements, indoctrination in the use of EN DES design procedures, design review, QA orientation, and QA techniques for upper management.

EN DES QAB has the responsibility for assuring that the proper engineering information and design criteria are used in generating design documents. This responsibility is partially fulfilled by an annually scheduled audit which specifically looks at a selected system in the design process. This audit sample is carefully reviewed to compare all inputs to the design including SAR commitments, codes, standards, and design criteria to the resulting design output (drawings, procurements, specifications, etc.). This comparison assures that all design inputs are correctly translated into appropriate design outputs. These audits are in addition to the reviews, checks, and verifications performed by in-line organizations responsible for design. As necessary, qualified engineering personnel are used to supplement the audit team and provide expert technical review.

A summary of the EN DES audit program is presented in Figure IV-2. In addition to these audits, other audits, not specific to Watts Bar, verify the adequacy of the design programs and processes which are also applicable to Watts Bar.

EN DES QAB maintains a computerized system for trending conditions adverse to quality which are documented on a Nonconformance Report form originated either by EN DES, by vendors (or by TVA shop representatives), or by the construction site and referred to EN DES for disposition. This data base goes back to 1977 and now provides data on over 6,000 NCRs for all TVA nuclear projects.

For the trend data bank, each nonconformance report has been force-fit-categorized into a 4-digit "root cause" code. The code denotes the type of component, type of problem, and organization responsible for the problem. The data bank of nonconformances can be searched on a variety of formats. Search formats include by root cause code for all projects; by root cause code for individual projects; alphabetically by supplier for vendor nonconformances; and by organization responsible for the problem. Key word search for a specific component or type of problem is also available.

This past year, capability was added to provide a summary printout of the "top 20" most frequently occurring root cause codes. Also, any of the various types of printout are now available by timeframe based on the nonconformance report dates. EN DES is now adding Licensing Event Reports and Preoperational Test Deficiency Reports to the data base. Trend Analysis Reports are reviewed by division level upper-management. Adverse trends are flagged to "first-line" management who are responsible for correcting and reversing unsatisfactory trends.

OEDC through EN DES QAB evaluates and approves all vendor QA programs as a necessary prerequisite to the awarding of the contract. EN DES QAB also reviews and signs EN DES purchase requisitions and recommendations of award of contracts. In addition to the internal design audits described above, EN DES QAB is also involved in an extensive program of auditing OEDC's vendors (including the NSSS supplier). OEDC currently has 216 vendors which are audited at least once every three years to verify implementation and conformance with the QA program approved by OEDC during the contract bid process. In 1982, EN DES QAB has scheduled 72 external audits of vendors associated with all TVA nuclear projects. This does not include followup audits which, if included, will result in over 100 audits in 1982 of TVA suppliers. A summary of the EN DES vendor audit program is shown in Figure IV-2.

OEDC has further assurance in the supplier program through another branch in EN DES, the EN DES Quality Engineering Branch (EN DES QEB). EN DES QEB determines if the manufacturers and suppliers of equipment and materials for TVA's nuclear plants fulfill the technical and quality requirements as defined in the procurement documents. The role of EN DES QEB enhances the involvement of EN DES QAB and, through their involvement, provides supplier surveillance for the purpose of selectively verifying that the required inspection and testing activities have been accomplished as specified. While most vendors are involved in QEB surveillances, this activity is applied based on an evaluation of the contract and its safety implications. To fulfill this role, EN DES QEB has nine regional TVA offices located in Birmingham, Alabama; Charlotte, North Carolina; Tulsa, Oklahoma; Los Angeles, California; Philadelphia, Pennsylvania; Pittsburgh, Pennsylvania; Providence, Rhode Island; St. Louis, Missouri; and Zurich, Switzerland to enable monitoring of these activities at the location of procurement or manufacture. In normal situations, the QEB surveillance activity includes a planning visit, routine surveillance visits, and source inspections resulting in the generation of inspection reports, shipping releases, and the receipt of technical data. In abnormal situations, the QEB activities may result in coordination with other TVA organizations to achieve controlled release of discrepant material through the OEDC nonconformance process, alteration of the contract provisions, transfer of manufacture away from the vendor to TVA or a third party, or a combination of the above.

The contract provisions usually leave the supplier completely responsible for his product development and performance verification but provide for the presence of OEDC representatives, along with the presentation of the work and quality records at specified times for TVA review. Certain "hold points" are specified in some contracts, in which case QEB has the responsibility of restraint on further manufacture until specific requirements have been satisfied.

The supplier is always responsible for inspections of their products and for the inspection records. The QEB review process may include some tests in addition to those performed by vendor personnel. The QEB surveillance can also include general observation of vendor operations. If the OEDC representative notes items that would act against TVA interest, he contacts the QEB Central Quality Control Staff in Knoxville who brings the matter to the attention of the technical engineer assigned to the contract in question. If the engineer deems necessary, he can involve upper management in order to satisfactorily resolve the situation. The average qualified experience of QEB field inspection engineers is well over ten years. Like the Chief of EN DES QAB, the Chief of EN DES QEB is under the management responsibility of the EN DES Division Manager.

The CONST QAB, similar to EN DES QAB, establishes the quality assurance program and directs and verifies the implementation of the quality assurance program established for the Division of Construction to fulfill the requirements of the 10CFR50, Appendix B criteria. CONST QAB reviews and approves CONST purchase requisitions for items which will be under the QA program as identified by the CONST line organization. They also review and approve all construction-originated division level procedures and site procedures.

CONST QAB also trends conditions adverse to quality for recurring conditions, cause and organization responsibility. The results of the trend program are assembled and reported quarterly to CONST upper management to keep them informed regarding all phases of construction activities.

The current CONST trend analysis results (October-December 1981) indicates that the most prevalent cause for audit deficiencies is "failure to follow procedure/instruction." In order to reverse this unsatisfactory trend, the WBN CONST Project Manager is in the process of adjusting the QA training program to provide clearer instruction regarding procedure requirements, particularly in the processing of QA records, and in reviewing procedures with the intent to provide simple instructions.

One strength of CONST QAB lies in the QA units established at the nuclear project sites. These site units are intimately involved in the monitoring of the daily construction activities which affect quality. Through the activities of this onsite organization, OEDC has additional assurance that construction is progressing using approved design outputs controlled by appropriate procedures. This onsite unit also reviews onsite engineering activities, construction work, quality control inspection activities, and QA program requirements implementation.

The EN DES QA Staff (now EN DES QAB) began conducting the internal design division audits of Watts Bar activities in mid-1971 and EN DES QA Staff first audited the NSSS supplier in mid-1972. Auditing of Watts Bar construction activities to verify the implementation of the OEDC QA program began in January 1973 with the Construction Engineer having audits conducted on specific construction activities and this practice continued until August 1974. In addition, the OEDC QA staff was formed during 1973 and they began the auditing of construction activities as well as conducting audits of EN DES. The audits conducted by the OEDC QA staff were detailed audits of activities which could affect plant safety. The OEDC QA Staff also audited TVA organizations outside of design and construction that provided support to the development of the Watts Bar program, such as the Divisions of Purchasing and Water Management.

In 1974, the Division of Construction established CONST QA Staff and, subsequently, the site QA Unit at WBN. The supervisor of this QA unit currently has 14 years of nuclear construction experience which includes eight years in nuclear quality assurance. The QA Site Unit is totally independent from the construction organizations of engineering, quality control, and trades and labor and reports offsite to CONST QAB management in Knoxville. In August 1974, the site QA Unit began to conduct audits of site construction activities in the electrical, mechanical, civil, general QA, and onsite vendor areas.

As the site QA unit matured, the OEDC QA staff gradually decreased its detail audits of site activities and replaced them with management audits of CONST management and the activities of the site QA unit. Similarly, as the internal division audit program in design expanded, the OEDC QA staff decreased the quantity of their audits. OEDC QA has continued to review both the EN DES QAB and the WBN QA unit's audit reports. These reports are reviewed for completeness of the audit per the original scope and purpose, the adequacy of the auditor's evaluation statement, and the adequacy of the significance determination for each deficiency. OEDC QA can and does upgrade audit deficiencies as necessary to significant as a result of this review. A summary of the OEDC QA audit program related to Watts Bar is shown in Figure IV-2.

Simplified matrices of the present QA audit system are shown in Figures IV-3 and IV-4. These matrices were developed based on the eighteen Appendix B criteria. Each QA organization is assigned responsibility for the applicable criteria. This system allows only a minimum overlap of audit responsibility yet ensures that all necessary criteria are reviewed on an annual basis.

All auditors are trained and qualified in accordance with Regulatory Guide 1.146, "Qualification of Quality Assurance Program Audit Personnel for Nuclear Plants" and ANSI N45.2.23, "Qualification of Quality Assurance Program Audit Personnel for

Nuclear Power Plants." As necessary, supplemental training is provided as additional audit preparation in specific areas, i.e. concrete, protective coatings, welding, nondestructive examination, etc. Each QA organization often augments an audit team with technically capable engineering personnel as illustrated early in EN DES QAB's review of design requirements. These individuals are designated as "technical specialists" and work as a member of the audit team under the supervision of a certified lead auditor.

All audit deficiencies are evaluated by the auditors and their supervisors for significance per 10CFR50, Appendix B. Those deficiencies designated as significant are transmitted immediately to the EN DES Nuclear Licensing Section to be evaluated for potential NRC 50.55(e) reportability and further processing if determined reportable. Corrective action for all audit deficiencies, including action to preclude recurrence for "significant" deficiencies, is mutually established by both the audited organization and the QA auditors and must be promptly implemented. Corrective action implementation is verified in followup audits and satisfactory completion of corrective action leads to closure of the audit deficiency by the auditors. A summary of the CONST audit program is presented in Figure IV-2.

All QA personnel and the Construction Engineer have stop work authority and responsibility. The Construction Engineer, in fulfilling his line responsibility to the CONST Project Manager for quality in site construction, generally issues Stop Work Orders (SWO). Often these orders are based on audit deficiencies identified by the site QAB unit. Of the 17 Stop Work Orders which have been issued at Watts Bar, 15 were issued by the Construction Engineer and 1 was issued by the site QAB unit. (This unique role of the Construction Engineer was discussed further in Section III). One Stop Work Order was issued jointly by all the QA organizations with OEDC QA assuming lead responsibility. This Stop Work Order concerned the lack of an established QA program for HVAC systems. This was a major problem area at Watts Bar and is discussed further in Section V.

2.0 <u>Other Independent Reviews</u>

In addition to the review and auditing done by these QA organizations, there are other internal and external organizations which further augment this review process.

One of the most extensive external reviews involving TVA's nuclear program is the certification and accreditation obtained by OEDC from the American Society of Mechanical Engineers (ASME) for compliance with the ASME Boiler and Pressure Vessel Code, Section III. OEDC's Division of Engineering Design was one of the first design organizations to be surveyed by ASME. This survey resulted in a certification in 1975 as Engineering Organization based on the demonstrated capability of the OEDC quality assurance program to ensure proper procurement and installation of ASME Code components. In 1976, OEDC was certified to a new ASME program as an N-Certificate Holder with a quality assurance program and organization capable of assuming overall responsibility for design, procurement, and construction of piping systems.

Certification by ASME is based on an onsite survey of the implementation of OEDC's quality assurance program. OEDC is resurveyed every three years by an ASME team of consultants and by OEDC's third party, independent inspection agency to ensure continued implementation of the quality assurance program. There is an additional review every six months by an on-site Inspection Specialist employed by the Authorized Inspection Agency (Hartford) for compliance with ASME quality assurance requirements. The Inspection Specialist is qualified in accordance with ANSI N626.0 to perform these reviews.

OEDC is also accredited by ASME as having a functioning quality assurance program and organization capable of performing the Owner's responsibilities in accordance with the Code. Additionally, OEDC, as the N-Certificate Holder assuming overall responsibility for ASME Code design and construction, approves the Division of Construction Quality Assurance Program, reviews internal audits and Authorized Inspection Agency concerns about the quality assurance program, and accompanies the Authorized Nuclear Inspection Supervisor on his semi-annual reviews.

Since 1976, OEDC's Division of Construction, Watts Bar Nuclear Plant, has been certified by ASME as an authorized fabricator (NPT-Certificate) of ASME code components and OEDC has been certified as an authorized installer (NA-Certificate) of ASME Code components. Watts Bar Nuclear Plant was the first TVA nuclear plant to petition for and receive these NPT certificates. This certification is also based on an onsite survey by ASME every three years of the implemenation of an acceptable quality assurance program. Authorized Nuclear Inspectors (ANI) employed by an independent Inspection Agency (Hartford) monitor the quality assurance and quality control programs daily. An onsite ANI has been at Watts Bar since 1976 and has identified 68 Nonsatisfactory Special Inspection Service Records. of these items remain open. The ANI's work and involvement in construction activities and OEDC's implementation of our quality assurance program is reviewed at least semi-annually by the ANI's supervisor in accordance with ANSI N626.0-1974.

In all their reviews, the ASME Survey Teams have reported that OEDC procedures and management controls are fully adequate and effective to implement the OEDC Quality Assurance Program. As a result, OEDC holds twenty-one Certificates of Authorization from ASME for design and construction at Watts Bar, Bellefonte, Hartsville, and Phipps Bend Nuclear Plants.

The Office of Power is also involved in the assurance function, for the plant POWER will eventually operate, in that OEDC has also established a joint audit program to verify the adequacy of the interface between OEDC (design and construction) and POWER (operator) as described in Section III. This audit program is in addition to the audit programs internal to both the Office of Engineering Design and Construction and the Office of Power. Joint audits utilize an experienced team of auditors from both POWER and OEDC. The lead auditor responsibility is routinely rotated between the two offices. The purpose of the Joint Audit Program is to verify the compliance of all interface activities with QA program requirements and to determine the effectiveness of control of interfaces among participating organizations. Deficiencies are documented in audit reports which are distributed to both OEDC and POWER management. Corrective action required to address the identified deficiencies is handled by the affected organization's management and administered through the organization's own internal QA program.

Additional coordination and control of interfaces is affected by the TVA Quality Assurance Steering Committee established to assure uniform interpretation and application of the quality assurance policies of TVA and requirements established by regulations, codes, and standards. The committee is comprised of executive, line, and QA management members from appropriate office-level and division-level organizations. In carrying out its objectives, the committee keeps members mutually informed on nuclear industry related quality issues; recommends new quality assurance policies; reviews quality trends and recommends corrective action; considers and recommends solutions to interdivisional quality assurance problems; arranges independent management reviews of the QA programs; and recommends ways of improving the effectiveness of these programs.

In addition to these reviews, the inspections performed by the Nuclear Regulatory Commission provided a meaningful feedback concerning quality problems. Watts Bar was one of the first nuclear plant sites to be assigned an onsite resident inspector. The resident inspector was assigned to Watts Bar in February 1980.

Since January 1978, NRC has identified 116 infractions at Watts Bar. This represents approximately 8200 inspector hours. Of these 116 infractions, TVA has issued a final report for all but one item. This has resulted in closure of 67 of the violations with the remaining 49 items awaiting further NRC followup or TVA action. TVA has continually sought to improve our timeliness and responsiveness to the identified violations and, in many cases, have benefitted from the implemented corrective action which has resulted in more detailed and comprehensive programs in affected areas.

TVA is also actively involved in the activities of the Institute of Nuclear Power Operations (INPO). TVA has loaned manpower to support INPO activities and has participated in INPO reviews of operating plants. Currently, TVA is working with INPO and other utilities to develop an industry program to perform independent evaluations of utilities' design and construction organizations and performance. This effort is currently directed toward the development of Performance Objectives and Criteria. Once completed, TVA anticipates requesting an INPO review of the TVA design and construction organization based on these developed objectives and criteria.

Internal and external management reviews are often performed to assess the overall OEDC organization. An example of an internal management review was the review performed in 1977 at the request of the Manager of OEDC and the Manager of Power. This management review dealt specifically with the QA Program and was conducted to assess the performance of all TVA organizational components (EN DES, CONST, OEDC, and POWER) involved in the QA Program activities. The objective of the review was to evaluate the effectiveness of the existing QA Program and to identify areas where the program effectiveness and value could be increased. The review team consisted of the Assistant to the Manager of OEDC, a representative from the Manager of POWER's office, and a consultant (Senior Vice President) from Nuclear Services Corporation. The review team examined available quality assurance related documents and interviewed numerous personnel involved in the QA Program and in the line functions. This review generated several recommendations aimed at strengthening the QA function and streamlining both the QA procedures and the necessary QA documentation required by these procedures. A followup review was conducted in 1978 to verify the corrective actions taken to address these recommendations.